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Original Research

Effect of smoking on the hematopoietic stem cell count in cord blood

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Abstract

Aim: The risk of undesirable and harmful effects of the negative environmental factors on fetal development during pregnancy has been extensively established. Smoking during pregnancy has been considered one of the important modifiable risk factors. Studies have shown that the hematopoietic stem cell content and the number of colony-forming units in cord blood obtained from pregnant women who smoke are low. The present study aimed to determine the rate of smoking among women who presented to our center to receive autologous cord blood banking services in Turkey. The study also aimed to compare the CD34+ hematopoietic stem cell counts in smoker and non-smoker cord blood donors.

Materials and Methods: This study is a cross-sectional and retrospective study. The product files of the first 1000 pregnant women who presented to our center for autologous cord blood donation and whose cord blood was procured for permanent storage were retrospectively analyzed. The SPSS 21.0 software package was used for statistical analysis. $P < 0.05$ was considered statistically significant. An independent two-sample test was used between the groups for comparing cord blood volumes, and the Mann–Whitney U test was used for comparing CD34 cell counts.

Results: The rate of smoking among pregnant women who presented to receive cord blood banking services was 0.22%, with the mean CD34+ cell counts being 2.0 × 106 and 2.6 × 106 in smokers and non-smokers, respectively. Moreover, the mean cord blood volumes were 81.3 and 85.1 mL in smokers and non-smokers, respectively.

Discussion: In Turkey, the rate of smoking behavior was low among those who applied to receive autologous cord blood banking services, and actual nationwide rates of smoking could be demonstrated using larger study groups if other centers also provide their results. The hematopoietic stem cell content of cord blood obtained from pregnant women who were smokers was lower than that obtained from non-smokers.

Keywords

Cord blood; Hematopoietic stem cell; Smoking

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Introduction

Smoking during pregnancy is considered one of the important modifiable risk factors associated with adverse pregnancy outcomes [1]. Some epidemiological data have shown that 20%–30% of women continued to smoke during their pregnancy [2]. However, a decrease in the rates of smoking among pregnant women has recently been reported in several countries [3]. In addition to the effects of smoking during pregnancy on fetal development, such as restricted growth and negative effects on the immune system [4], it has extensively been recognized that smoking causes an increased incidence of complications, such as substantial metabolic and biochemical changes, as well as adaptive responses in both the fetus and the mother, resulting in spontaneous abortion, placental abruption, preterm birth, intrauterine growth restriction, and stillbirth [5, 6].

Cord blood is an important resource owing to its hematopoietic stem cell content. In particular, in recent years, the use of hematopoietic stem cell transplantation therapy, also known as bone marrow transplantation, has become more common. Cord blood that contains a sufficient amount of stem cells is used in transplantations to siblings and unrelated patients because cord blood can be collected and processed during birth and cryopreserved for several years [7]. The number of studies concerning cord blood obtained from mothers who smoke is limited in the literature. Reportedly, the hematopoietic stem cell content and colony-forming unit (CFU) counts were low in cord blood obtained from mothers who smoke [8].

The purpose of the present study was to determine the rate of smoking among women who presented to our center to receive autologous cord blood banking services in Turkey. Further, the study aimed to compare the CD34+ hematopoietic stem cell counts in smoker and non-smoker cord blood donors.

Material and Methods

In this cross-sectional retrospective study, the product files of the first 1000 pregnant women who presented to our center for autologous cord blood donation and whose cord blood was procured for permanent storage were retrospectively analyzed. First, the rate of smoking was determined in pregnant women who applied for cord blood donation. Thereafter, the CD34+ hematopoietic stem cell counts were compared between equal numbers of women who answered positively and negatively to the question “Do you smoke” on the completed form obtained before cord blood collection. Further, cord blood volume, which is an important parameter that determines cord blood quality, was compared between the two groups. Approval for the study was obtained from the Clinical Research Ethics Committee of Akdeniz University Medical Faculty with the decision number 147 (dated 02.21.2018). The SPSS 21.0 software was used for statistical analyses. $P < 0.05$ was considered to indicate statistical significance. An independent two-sample test was used for comparing cord blood volumes, and the Mann–Whitney U test was used for comparing CD34+ cell counts between both groups.

Results

The study included data of the first 1000 donations from women who presented to our center to receive autologous cord blood banking services and whose blood was placed into permanent (long-term) storage. The rate of smoking was 0.22%. The cord blood volumes obtained from equal numbers of smokers and non-smokers were evaluated. No significant difference was observed between the two groups (Figure 1).

Hematopoietic stem cell counts (CD34+ cells) were compared between the two groups. The CD34+ cell count of the smoker group was significantly lower than that of the non-smoker group (Figure 2).

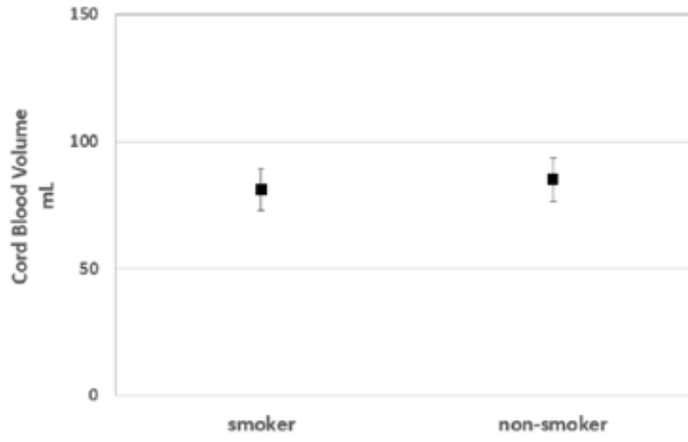

Figure 1. Cord blood volumes obtained from smoking and non-smoking pregnant women (n = 20 for each group, $P > 0.05$)

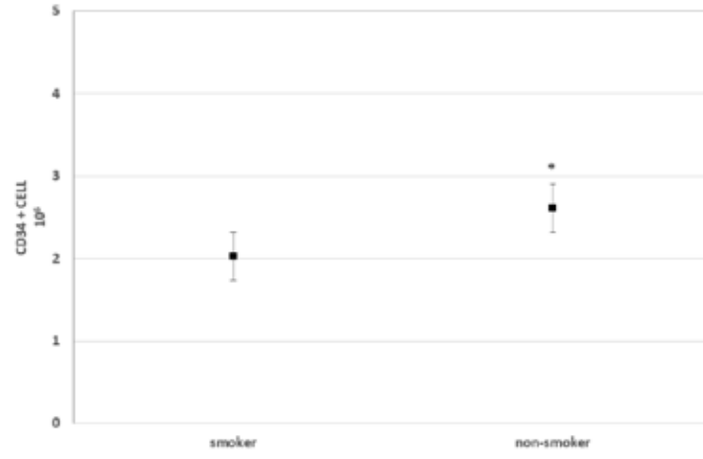

Figure 2. CD34+ cell counts in cord blood obtained from smoking and non-smoking pregnant women (n = 20 for each group, * $P < 0.05$)

Discussion

The practice of cord blood banking has developed in the last 30 years [9]. Although cord blood was used in bone marrow transplantation as a source of hematopoietic stem cells in the 1990s, it has recently been used in regenerative and reparative medicine. This preference for cord blood in such medical practices can be attributed to the mesenchymal stem cells contained in it [10]. Other important reasons for preferring cord blood include its ability to be frozen and stored for long-term use and the ease of access to cord blood within a short period of time, if needed. Besides these, studies on the expansion of hematopoietic and mesenchymal stem cells contained in

cord blood have successfully been ongoing in the laboratory environment [11, 12]. Cord blood, preferred in this respect, is accepted as an important source of stem cells.

In studies evaluating the quality and use of cord blood, the donor, newborn, cord blood content, collection, transfer and placenta were identified as the main factors [13]. Studies evaluating the rate of smoking among cord blood donors and its effect on hematopoietic stem cell count are scarce. Although the number of samples differs in these studies, it was emphasized that smoking had a negative impact on the number of CD34+ hematopoietic stem cells [14-16]. In Turkey, cord blood banking has exhibited rapid growth in the last 10 years. Currently, one center is present per 10 million individuals. The main type of banking, termed the Turkish Model in the literature, can co-implement the autologous and allogeneic banking models.

All pregnant women included in this study presented to our center for autologous cord blood storage. The aim was to preserve cord blood for their children in case of any requirement in the future, wherein the costs of storing cord blood are covered by the families. In the present study evaluating the first 1000 donations, the rate of smoking among pregnant women who applied for cord blood storage was 0.22%, and this rate was considerably lower compared to the overall rate of smoking among pregnant women [17]. No significant difference was observed between smoking and non-smoking pregnant women in terms of cord blood volumes. However, larger studies are needed to support this result, considering that various factors affect blood volume (factors related to the mother and child, the experience of the physician collecting cord blood, etc.). The number of CD34+ hematopoietic stem cells was significantly lower in the group of pregnant women who smoked than in non-smokers. In this regard, the study results are consistent with those of previous studies in the literature.

Conclusion:

The hematopoietic stem cell content of cord blood obtained from pregnant women who were smokers was lower than that obtained from non-smokers. The rate of smoking was low among women applying for autologous cord blood banking services in Turkey, and the overall nationwide rate of smoking can be determined with large study groups that include findings from other centers.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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